Introduction to EMDS

What is EMDS?

Ecosystem Management Decision Support (EMDS) is software used to develop and run decision support models. These models can be used to conduct objective ecological assessments by integrating diverse kinds of data, such as in-channel habitat indicators and upslope vegetation. Key features of EMDS include transparent analysis process, consistent interpretation of data, identifying gaps in data, and research needs. EMDS is an extension of ArcGIS (or ArcView) and can be used to conduct assessments at any geographic scale.

How can I use EMDS?

Uses of EMDS include:

- Assessments of current ecological condition and changes in condition over time at any spatial or temporal scale.
- Estimations of how a proposed management activity will impact ecological condition, including the magnitude of impact.
- Prioritization of restoration efforts and data collection. Assessments are transparent, therefore explanations to stakeholders are very easy and logical.

EMDS is available free of charge on the web.
http://www.fsl.orst.edu/emds

How does EMDS work?

EMDS evaluates individual data then aggregates this information to make an over all assessment of condition. Evaluation criteria are developed by the user (or expert panels of users) to evaluate individual data parameters. Data are compared to the criteria and given an evaluation score that ranges between (+)1 and (–)1 (Figure 1), where (+)1 indicates that the resource is in "good" condition (technically, the data fully support the premise that the resource is in acceptable condition). A value of (–)1 indicates that the resource is "poor" condition (i.e., the data do not support the premise that the resource is in acceptable condition). Evaluation scores between (-) 1 and (+) 1 reflect the gradient that lies between "good" and "poor" condition. The EMDS evaluation process is much like that used by the National Marine Fisheries Service (NMFS) Matrix of Pathways and Indicators. The difference between the two processes is that the NMFS procedure places data into the categories of "properly functioning," "at risk," and "not-properly functioning," whereas EMDS uses a continuum between "good" and "poor" condition.

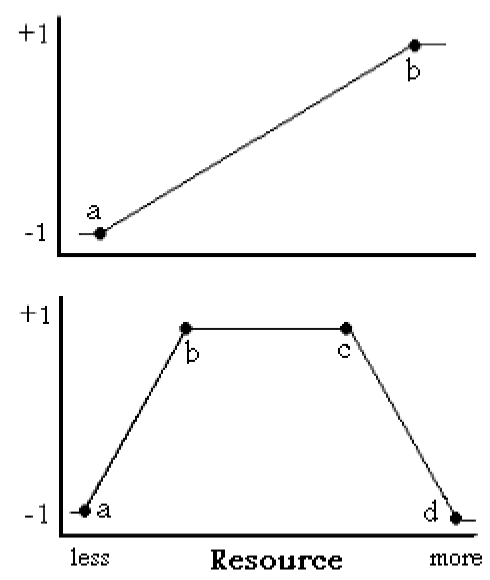

Figure 1. Evaluation curve possibilities, using two or four criteria.

Criteria curves may be constructed in several ways, using a maximum of four criteria. The top panel in Figure 1 shows an instance where two criteria were used, including one criterion for "good" condition (point b), and one for "poor" condition (point a). The lower panel in Figure 1 shows the use of four criteria. In this instance, a range of "good" condition values exist (between points b and c). This type of criteria curve could be used to evaluate water temperature, for example, where a range of values is acceptable for good fish production. Temperatures outside the acceptable range become increasingly detrimental to fish production.

To assess condition, individual evaluation scores are aggregated into a single score (range = (-)1 to (+)1) using user-defined rules. Rules that produce a score weighted toward the resource in either the "best" or "worst" condition may be used. Alternatively, a score can be based on the unweighted average of the indicator evaluation scores. Selection of the rules should be based on knowledge of the system and ecological processes. The "worst-case" scenario would be

How does EMDS work? (continued)

used to allow a single variable to override other variables. For example if the user is evaluating the ability of a stream reach to support fish, water temperature may be allowed to override other habitat attributes because if the water is too warm, it doesn't matter how many pools are present. Conversely, an average could be used if habitat variables in "good" condition can compensate for those in "poor" condition. In addition to controlling how scores are aggregated, the user may also weight specific indicators relative to their importance in the analysis.

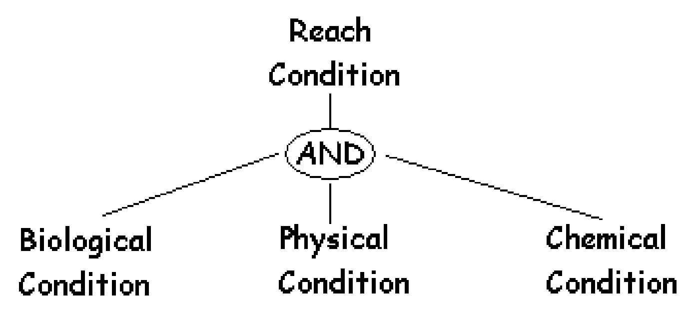

Figure 2. Example model structure. The rule (AND in this example) determines how the evaluation scores of the biological, physical, and chemical condition evaluation scores are aggregated.

In the simplified model structure shown in Figure 2, the condition of a stream reach is determined using the average of biological, physical, and chemical conditions in the reach that has been weighted toward the lowest score (which reflects the "poorest" condition). The factors contributing to reach condition (biological, physical, and chemical condition) are each determined by aggregating the evaluation scores of attributes. For example, chemical condition may be the aggregated score of dissolved oxygen, pH, and heavy metal concentrations in the reach.

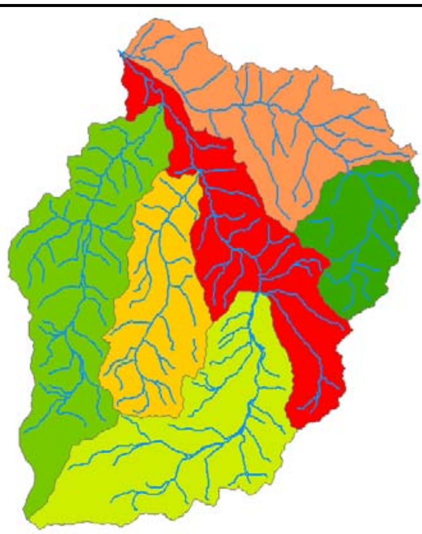

Figure 3. Example model output for a watershed-level analysis. Shown are 6th-field subwatersheds color coded according to condition.

What do the model results look like?

The model output includes a map of the analysis area that indicates the current status of resource condition. Shown in Figure 3 is a 5th-field watershed and its associated 6th-fields. In this example, analysis was performed at the subwatershed scale and individual 6th-fields are colored according to condition. By running the model using data from time 0 and time 1, we can examine changes in resource condition. For example, one could evaluate stream survey data from 1996 and 1998 to examine the impacts of the 1997 flood on watershed condition. Although decision support models can not be used for predicting future trends, EMDS does contain tools for conducting "what if" scenarios. For example, one can estimate how watershed condition will improve if 500 pieces of large wood were added to the stream.

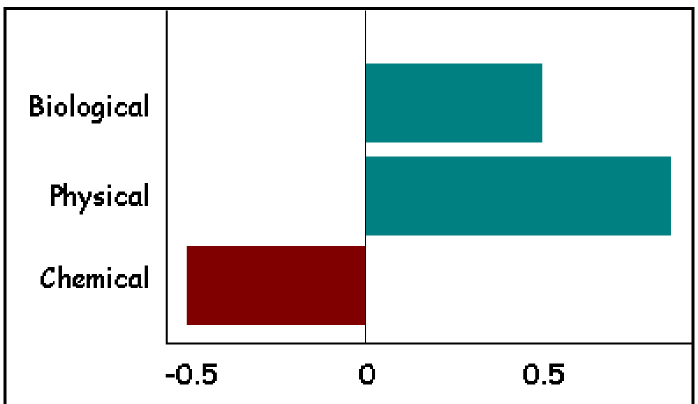

Figure 4. Contribution of biological, physical, and chemical factors to reach condition scaled from (-1) to (+) 1.

In addition to map products, EMDS analyzes the contribution of individual data parameters to the overall condition score. This information can be used to identify types of restoration projects needed within watersheds. In Figure 4, the biological and physical components of the analysis are contributing positively to the overall score, whereas the chemical component is not. Restoration efforts should therefore be directed toward the causes of chemical impairment. A look at the attributes included in the chemical condition analysis should help the user focus on the those attributes contributing the most to the negative score. Because analyses are conducted in ArcGIS, we can use queries to look at impairment across large spatial scales. We can ask questions such as "of the watersheds in poor condition, which have road density lower than X?" This type of analysis can assist in determining which watersheds need restoration or to examine the extent of a disturbance. When it comes time to prioritize restoration, the EMDS package includes an application that makes these prioritizations easy.

Aquatic/Riparian Effectiveness Monitoring Program

AREMP

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